TECHNOLOGY NEEDS/OPPORTUNITIES STATEMENT

LONG-LIFE WASTE ISOLATION SURFACE BARRIER

Identification No.: RL-SS17
Date: September 2001

Program: Environmental Restoration
OPS Office/Site: Richland Operations Office/Hanford Site
Operable Unit(s): 200 Area Remedial Action and Waste Management Units
PBS No.: RL-CP01 (RL-ER02)
Waste Stream: Disposition Map Designations: ER-14 [technical risk score 5]
TSD Title: N/A
Waste Management Unit (if applicable): N/A
Facility: N/A

***Priority Rating*:**

This entry addresses the "Accelerated Cleanup: Paths to Closure (ACPC)" priority:

_X_ 1. Critical to the success of the ACPC
____ 2. Provides substantial benefit to ACPC projects (e.g., moderate to high lifecycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays)
____ 3. Provides opportunities for significant, but lower cost savings or risk reduction, and may reduce uncertainty in ACPC project success

The four major core projects of the Groundwater/Vadose Zone Integration Project (200 Area Remediation, Immobilized Low-Activity Waste Performance Assessment, Tank Farm Closure, and Tank Farm Vadose Zone) list this need as their highest priority.

Need Title: Long-Life Waste Isolation Surface Barrier

Need/Opportunity Category: Technology Need

Need Description: Surface barriers are remediation options for Hanford waste sites contaminated with low-level radionuclides and transuranics and/or chemical contaminants. In some cases, the radioactive contaminants have half-lives of thousands of years. Concern exists regarding the integrity of barrier designs and the definition of adequate testing to verify barrier performance. This technology need relates to the generation and subsequent regulatory acceptance of adequate design, selection, validation, and monitoring results. Acceptance of these results will allow an environmentally sound, cost-effective, graded design approach for barrier implementation at the Hanford site.

Long-term monitoring techniques are also needed to support monitoring of barrier performance and long-term stewardship of contaminated soils.

Schedule Requirements:

Earliest Date Required: 8/1/99

Latest Date Required: 9/30/15

Construction of surface barriers at a significant scale will likely start in FY2008 when all assessments are required to be completed. To have RODs in place for barriers by FY2008, significant performance data is still needed. Long-term monitoring techniques, are currently needed to collect performance monitoring data for the existing Hanford Barrier and to plan the monitoring program for a modified RCRA C barrier treatability test which is expected to start in FY2002. Remediation of the 200 Area is currently planned to continue through 2018.

***Problem Description*:** Fifty years of defense plutonium production resulted in the creation of a large number of solid waste burial ground sites in Hanford's 100, 200, and 300 Areas. The 200 Area is located on the central plateau and contains the spent fuel extraction and processing facilities and the radioactive waste storage tanks. Hanford's burial grounds contain a variety of solid waste debris, including construction waste, discarded equipment, and protective clothing. Much of this waste is contaminated with low-level radioactive materials, as well as transuranics.

The 200 Area remediation includes a combination of removal and leave in-place with in situ treatment and/or surface barrier placement strategies. Sites within areas that will be used for waste management and other industrial uses or sites where capping provides better, more cost effective protection of human health and the environment are the main candidates for surface barriers. The majority of waste sites in the 200 Areas are expected to be remediated with surface barriers. Failure to establish acceptable graded surface barrier could result in excavation requirements that would be cost prohibitive.

In FY 1998, Bechtel Hanford Inc. and Pacific Northwest National Laboratory completed four-years worth of full-scale performance testing and monitoring for the Hanford Prototype Barrier as part of a treatability test. Additional, but more focused field performance testing and monitoring continues to date to enhance the long-term performance record. The purpose of this treatability test was to demonstrate the effectiveness of construction techniques and barrier performance. Data from this test could also be used to demonstrate acceptability of less robust graded barriers for use at the Hanford Site, since they share common design features. Data collected to date shows that the barrier works as designed, but an acceptable methodology for extrapolating short-term data into long-term performance is still required. In addition, full-scale performance testing is needed for the other graded barrier designs which are expected to have broader application in the 200 Areas than the Hanford Barrier design.

As barrier deployment enters the detailed design phase, considerations relating to performance of adjacent barriers (and interconnected barriers), side-slope stability, and waste site identification/warning systems will need to be addressed.

Areas that are presently not funded that require further study prior to deployment of barriers at waste sites include:

(1) Confirming the longevity and durability of the low permeability layer (e.g., asphalt or geomembrane) by conducting accelerated aging tests and stress/strain analysis to ensure that this component will not degrade during its proposed design life.
(2) Evaluating long term monitoring techniques, including a long term, easy to use, soil moisture measurement device to monitor the cap performance. These techniques would ideally be automated and non-intrusive with minimal potential for creating a preferential pathway circumventing the barrier integrity.
(3) Evaluating the potential for differential settlement of soils and wastes beneath the surface barrier and the impacts of this differential settlement on barrier integrity are required to establish maximum allowable settlement criteria;
(4) Developing a model for extrapolating short-term data to address long-term performance that is acceptable to the DOE and regulators;
(5) Evaluating alternate materials (e.g., to asphalt) and reduced thicknesses of the barrier components to allow a graded approach to barrier application;
(6) Side slopes that use coarse materials such as gravel or large rocks for slope stability increase infiltration in those areas. This edge effect needs to be analyzed to determine if this is a significant issue that requires design changes;
(7) Techniques for subgrade modification or engineering stabilization of waste forms are needed to provide a stable foundation for emplacement of a surface barrier (e.g., decrease void space to eliminate subsidence potential and minimize differential settlement)

Benefit to the Project Baseline of Filling Need: Improved information about barrier performance and appropriate barrier designs will aid in selecting the most cost effective remediation approach.

***Functional Performance Requirements*:** Major regulatory drivers for cover design are 10 CFR 61 (NRC), 40 CFR 264 and 265 (RCRA), and 40 CFR 191 (EPA). Performance criteria for barrier designs depend on waste categories. DOE/RL has identified three conceptual surface barrier design options that provide various levels of environmental protection to provide a graded approach for isolation of different types waste (DOE/RL-93-33, Rev. 0). The most robust barrier design presently identified is the "Hanford Barrier" with a design life of 1,000 years, water infiltration limits to less than 0.05 cm/yr and erosion limits of less than 4,500 kg/ha (2 tons/acre).

Work Breakdown Structure (WBS) No.* :** 1.4.03.3.1 (RL-CP01) ***TIP No.: TIP 0002

Relevant PBS Milestone: PBS-MC-027, M-15-00, M-16-00

***Justification For Need*:**

Technical: Installation of long-term barrier options with design lives of hundreds or more years requires very high quality testing to confidently predict design performance.

Regulatory: CERCLA, RCRA, MTCA provides requirements for environmental remediation. DOE Order 435.1 (Radioactive Waste Management) provides requirements for radioactive waste.

Environmental Safety and Health: A properly installed barrier will significantly reduce risk to human health and the environment at uncontrolled surface waste sites.

Potential Life-Cycle Cost Savings of Need (in $000s) and Cost Savings Explanation: The estimated life-cycle cost savings associated with filling this need is $300M. This estimate is based on an assumed savings of 10% of the total cost for the 200 Area of $2.8B.

Cultural/Stakeholder Concerns: Hanford stakeholders have expressed the desire for highly predictive performance testing of barrier designs prior to selection of barriers as remediation options at waste sites. Additionally, a major environmental impact identified in the Hanford Remedial Action Environmental Impact Statement is the mining of materials for surface barrier construction from the McGee Ranch of the Hanford Site. The McGee Ranch area is a wildlife corridor that many see as vital in maintaining the unique shrub steppe biological community in the area.

Other: This need is DOE complex wide for remedial action and waste management units. This need is also applicable to other US government agencies, as well as private environmental restoration activities.

Current Baseline Technology: Excavate and dispose.

Cost: Currently, surface barriers are the selected baseline approach for many of the waste sites in the 200 Area.

Waste: None

How Long It Will Take: Waste site remediation activities in the 200 Area are currently planned to continue through 2018.

End-User: Richland Environmental Restoration Project, River Protection Project Tank Farm Closure Program, River Protection Project Immobilized Waste Program

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